What is claimed is:

1. An apparatus for non-intrusively sensing fluid flow within a petroleum well pipe, said apparatus comprising:

an acoustic signal sensing array having a plurality of sensors, each sensor including a coil of optical fiber wrapped a plurality of turns around a circumference of said pipe;

wherein optical power sent from a source connected to said apparatus travels into said acoustic signal sensing array and said acoustic signal sensing array produces a first signal relating to said acoustic signal;

a local pressure variation sensing array having a plurality of sensors, each sensor including a coil of optical fiber wrapped a plurality of turns around said circumference of said pipe;

wherein optical power sent from said source travels into said local pressure variation sensing array and said local pressure variation sensing array produces a second signal relating to said local pressure variation; and

a housing attached to said pipe for enclosing said sensing arrays.

2. The apparatus of claim 1, wherein said acoustic signal sensing array further includes at least one reflective element disposed between sensors.

3. The apparatus of claim 2, wherein said reflective element is a fiber Bragg Grating.

4. The apparatus of claim 1, wherein said sensors within said acoustic signal sensing array are spaced to sense acoustic signals traveling at the speed of sound through said fluid, and said first signal relating to said acoustic signals can be used to determine a speed of sound for said fluid within said pipe.

5. The apparatus of claim 4, wherein said sensors within said acoustic signal sensing array are spaced a known or determinable distance or distances apart.

6. The apparatus of claim 5, wherein said sensors within said acoustic signal sensing array are spaced equidistant.

7. The apparatus of claim 1, wherein said sensors within said local pressure variation sensing array are spaced to sense local pressure variations traveling with said fluid flow, and said second signal relating to said local pressure variations can be used to determine a velocity for said fluid flow within said pipe.

8. The apparatus of claim 7, wherein said sensors within said local pressure variation sensing array are spaced a known or determinable distance or distances apart.

9. The apparatus of claim 8, wherein said sensors within said local pressure variation sensing array are spaced equidistant.

10. The apparatus of claim 1, wherein said housing attached to said pipe forms a pressure vessel having an annular region disposed enclosed between said housing and said pipe, and said sensing arrays are disposed in said annular region.

11. The apparatus of claim 1, wherein said pipe is sufficiently compliant so that said acoustic signals and said local pressure variations may be sensed through a wall of said pipe.

12. An apparatus for non-intrusively sensing fluid flow within a pipe, said apparatus comprising:

a first sensing array for sensing signals traveling at the speed of sound through said fluid flow within said pipe, said first sensing array having a plurality of first sensors each including a coil of optical fiber wrapped a plurality of turns around a circumference of said pipe;

a second sensing array for sensing local pressure variations traveling with said fluid flow, said second sensing array having a plurality of second sensors

each including a coil of optical fiber wrapped a plurality of turns around said circumference of said pipe; and

a housing attached to said pipe for enclosing said sensing arrays.

13. An apparatus for non-intrusively sensing fluid flow within a pipe, said apparatus comprising:

a speed of sound sensor that includes an array of first sensors for sensing acoustic signals, each first sensor including a coil of optical fiber wrapped a plurality of turns around a circumference of said pipe, and wherein optical power sent from a source connected to said apparatus travels into said array of first sensors and said array of first sensors produces a first signal relating to said acoustic signals;

a fluid flow velocity sensor that includes an array of second array sensor for sensing local pressure variations, each second sensor including a coil of optical fiber wrapped a plurality of turns around said circumference of said pipe, and wherein optical power sent from said source travels into said array of second sensors and said array of second sensors produces a second signal relating to said local pressure variations; and

a housing attached to said pipe for enclosing said sensing arrays.

14. An apparatus for non-intrusively sensing fluid flow within a pipe, said apparatus comprising:

a sensing array for sensing signals traveling at the speed of sound through said fluid flow within said pipe, said sensing array having a plurality sensors, each sensor including a coil of optical fiber wrapped a plurality of turns around a circumference of said pipe; and

a housing attached to said pipe for enclosing said sensing array;

wherein optical power sent from a source connected to said apparatus travels into said sensing array and said sensing array produces a response signal relating to said signals traveling at the speed of sound.

15. The apparatus of claim 14, wherein said sensing array further includes at least one reflective element disposed between sensors.

16. The apparatus of claim 15, wherein said reflective element is a fiber Bragg Grating.

17. The apparatus of claim 14, wherein said response signal can be used to determine a speed of sound for said fluid within said pipe.

18. The apparatus of claim 14, wherein said sensors within said sensing array are spaced equidistant.

19. An apparatus for non-intrusively sensing fluid flow within a pipe, said apparatus comprising:

a sensing array for sensing local pressure variations traveling with said fluid flow, said sensing array having a plurality of sensors, each sensor including a coil of optical fiber wrapped a plurality of turns around a circumference of said pipe; and

a housing attached to said pipe for enclosing said sensing array;

wherein optical power sent from a source connected to said apparatus travels into said sensing array and said sensing array produces a response signal relating to said local pressure variations.

20. The apparatus of claim 19, wherein said signal relating to said local pressure variations can be used to determine a velocity for said fluid flow within said pipe.

21. The apparatus of claim 19, wherein said sensors within said sensing array are spaced
equidistant.

22. An apparatus for non-intrusively sensing fluid flow within a pipe, said apparatus comprising:

a first sensing array for sensing signals traveling at the speed of sound through said fluid flow within said pipe, said first sensing array having a plurality of first sensors each including a coil of optical fiber attached to said pipe;

a second sensing array for sensing local pressure variations traveling with said fluid flow, said second sensing array having a plurality of second sensors each including a coil of optical fiber attached to said pipe; and

a housing attached to said pipe for enclosing said sensing arrays.

23. An apparatus for non-intrusively sensing fluid flow within a conduit, said apparatus comprising:

a speed of sound sensor that includes an array of first sensors for sensing acoustic signals, each first sensor including a coil of optical fiber wrapped one or more turns around a circumference of said pipe, and wherein optical power sent from a source connected to said apparatus travels into said array of first sensors and said array of first sensors produces a first signal relating to said acoustic signals;

a fluid flow velocity sensor that includes an array of second array sensor for sensing local pressure variations, each second sensor including a coil of optical fiber wrapped one or more turns around said circumference of said pipe, and wherein optical power sent from said source travels into said array of second sensors and said array of second sensors produces a second signal relating to said local pressure variations; and

a housing attached to said pipe for enclosing said sensing arrays.

24. An apparatus for non-intrusively sensing fluid flow within a conduit, said apparatus comprising:

a speed of sound sensor that includes an array of first sensors for sensing acoustic signals, each first sensor including a coil of optical fiber wrapped one or more turns disposed substantially around a circumference of said pipe, and wherein optical power sent from a source connected to said apparatus travels into

said array of first sensors and said array of first sensors produces a first signal relating to said acoustic signals;

a fluid flow velocity sensor that includes an array of second array sensor for sensing local pressure variations, each second sensor including a coil of optical fiber wrapped one or more turns substantially around said circumference of said pipe, and wherein optical power sent from said source travels into said array of second sensors and said array of second ~~sensors~~ produces a second signal relating to said local pressure variations; and

a housing attached to said pipe for enclosing said sensing arrays.

add a'7